- Utilize 16 target sites: 0ne at the tailrace TDG station of each dam and 1 at the mouth of the Columbia.

- Utilize three time periods:
  - River Warming up: Jan 1 - May 31.
  - Site Potential temperature exceeds criteria: June 1 - September 15.
  - River Cooling September: 16 - Dec 31.

- TMDL Targets

Columbia

OR/WA Border to the Coast

Jan 1 - May 1	*June 1 - September 15*	*September 16 - December 31*
SP + 0.3/source or SP + 1.1	SP + 0.14	SP + 0.3/source or SP + 1.1

Grand Coulee Dam to the OR/WA Border

Jan 1 - May 1	*June 1 - September 15*	*September 16 - December 31*
t=34/(T+9)	SP + 0.3	t=34/(T+9)

Canadian Border to Grand Coulee Dam

Jan 1 - May 1	*June 1 - September 15*	*September 16 - December 31*
t=23/(T+5)	SP + 0.3	t=23/(T+5)

Snake

Columbia River Confluence to Clearwater River

Jan 1 - May 1	*June 1 - September 15*	*September 16 - December 31*
t=34/(T+9)	SP + 0.3	t=34/(T+9)

- Ran 30 years of simulations of the Site Potential River and the Impounded River

  - We know the variability in the difference between Site Potential and Impounded at daily intervals for 30 years.

- Made a policy decision to address the 90^{th} percentile difference between Site Potential and Impounded temperature. This is in lieu of establishing critical conditions but analogous to using $7Q_{10}$ flow as a critical condition for point sources.

- Made a policy decision that the TMDL and load allocations will be expressed in terms of temperature reductions needed at the target sites. (Loading capacity can be expressed as watts and necessary reductions in watts can be calculated for each site).

- Ran 30 years of simulations to establish the allocations:

    - Starting upstream and proceeding target site by target site we computed the reductions in temperature to meet WQS at each target site.

        - For the summer period when site potential exceeds criteria this works fairly well.

        - In the winter during the cooling period, site potential is nearly always equal to or greater than actual, so no temperature reductions are needed.

        - *In the third period of the year, this approach does not work.*

            - In the lower Columbia (OR/WA Border to Coast) WQS are not attained. The resulting temperature exceeds SP + 1.1.

    - We started over, back upstream, trying to allocate the further reductions equally among the upstream dams in the Snake and the Columbia.

    - However equal reductions at the dams don't have equal effects downstream.

        - If we were 0.7 °C over SP+1.1 in the Columbia just upstream of the Snake and we allocated .1 further reduction to each of the 7 upstream dams we would not get the needed 0.7 improvement.

        - Grand Coulee needs greater reductions than the others cause it has greater effects.

    - We arrived at an allocation that complies with WQS nearly 100% of the time. There are some unexplained glitches and out-liars but it complies 99% of the time.

    - We then ranked the 10950 needed reductions (daily for 30 years) and determined the 90^{th} percentile value. 90% of the needed reductions are equal or lower than the 90^{th} percentile value.

Target Site	Reduction when SP Exceeds Criteria (°C)	Reduction when SP is less than Criteria (°C)
Grand Coulee	2.82	4.4
Chief Joseph	0.662	0.71
Wells	0.961	0.935
Rocky Reach	0.7	0.71
Rock Island	0.68	0.65
Wanapum	0.78	0.71
Priest Rapids	0.896	0.78
McNary	0.82	0.82
John Day	0.77	0.78
The Dalles	0.811	0.77
Bonneville	0.862 (2.6)	0.887
Lower Granite	1.066	1.718
Little Goose	1.304	2.03
Lower Monumental	0.955	1.22
Ice Harbor	1.754 (2.4)	2.41